REMARKS

By the present amendment and response, claims 1, 9, and 15 have been amended to overcome the Examiner's objections. Claims 1-3, 6-7, 9-10, 13, 15-16, and 19 are pending in the present application. Reconsideration and allowance of pending claims 1-3, 6-7, 9-10, 13, 15-16, and 19 in view of the following remarks are requested.

A. Rejection of Claims 1-3, 6, 9-10, and 15-16 under 35 USC §102(b)

The Examiner has rejected claims 1-3, 6, 9-10, and 15-16 under 35 USC §102(b) as being anticipated by U.S. patent number 6,190,975 to Kubo et al. ("Kubo"). For the reasons discussed below, Applicants respectfully submit that the present invention, as defined by amended independent claims 1, 9, and 15, is patentably distinguishable over Kubo.

The present invention, as defined by amended independent claims 1 and 9, includes, among other things, a first gate dielectric having a first coefficient of thermal expansion and a first gate electrode having a second coefficient of thermal expansion, where "said first gate dielectric and said first gate electrode are selected such that a difference between said second coefficient of thermal expansion and said first coefficient of thermal expansion causes an increase in carrier mobility in said FET." As disclosed in the present application, a FET includes a gate electrode layer situated over a gate dielectric layer, where the gate electrode layer and the gate dielectric layer are selected such that the gate electrode layer has a coefficient of thermal expansion ("CTE") that is

higher than a CTE of the gate dielectric layer. As disclosed in the present application, as a wafer comprising the gate electrode and gate dielectric layers cools down after the gate electrode layer has been deposited at high temperature, the gate electrode layer decreases in size to a greater extent (i.e. shrinks more) than the gate dielectric layer. As disclosed in the present application, as a result, tensile strain is created in a channel situated underneath the gate dielectric, which advantageously increases carrier mobility in the FET.

As disclosed in the present application, in one embodiment, the FET is a PFET while gate dielectric and gate electrode layers are selected such that the gate dielectric layer has a CTE that is higher than the CTE of the gate electrode layer. In such embodiment, compressive strain is created in the channel underneath the gate dielectric layer, which increases carrier mobility in the PFET. Thus, by selecting gate electrode and gate dielectric layers of a gate stack to have appropriate respective coefficients of thermal expansion, the present invention achieves increased tensile strain in the channel of a FET. As a result, the present invention advantageously achieves increased carrier mobility in the FET, which results in increased FET performance.

In contrast, Kubo does not teach, disclose, or suggest a first gate dielectric having a first coefficient of thermal expansion and a first gate electrode having a second coefficient of thermal expansion, where "said first gate dielectric and said first gate electrode are selected such that a difference between said second coefficient of thermal expansion and said first coefficient of thermal expansion causes an increase in carrier

mobility in said FET." Kubo specifically discloses an NMOS transistor including SiGeC layer 14n, gate insulating layer 19n, and gate electrode 18n, where gate electrode 18n is situated over gate insulating layer 19n and gate insulating layer 19n is situated over SiGeC layer 14n, which serves as channel. See, for example, column 9, lines 7-23 and Figure 1 of Kubo. In Kubo, the composition rates of the respective elements in SiGeC layer 14n are set such that SiGeC layer 14n and Si layer 13n immediately therebelow are fitted in lattice for each other. See, for example, column 8, lines 57-61 and Figure 1 of Kubo.

In Kubo, in SiGeC layer 14n, the electron mobility is higher than in the Si layer, thus increasing the operational speed of the NMOS transistor. See, for example, Kubo, column 9, lines 4-6. However, Kubo fails to teach, disclose, or suggest a first gate dielectric and a first gate electrode being selected such that a difference between the second coefficient of thermal expansion of the first gate electrode and the first coefficient of thermal expansion of the first gate dielectric causes an increase in carrier mobility in the FET. Furthermore, Kubo fails to even mention a coefficient of thermal expansion.

For the foregoing reasons, Applicants respectfully submit that the present invention, as defined by amended independent claims 1 and 9, is not taught, disclosed, or suggested by Kubo. Thus, amended independent claims 1 and 9 are patentably distinguishable over Kubo. As such, the claims 2-3 and 6-7 depending from amended independent claim 1 and claims 10 and 13 depending from amended independent claim 9

are, *a fortiori*, also patentably distinguishable over Kubo for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The present invention, as defined by amended independent claim 15, includes, among other things, a first gate dielectric having a first coefficient of thermal expansion and a first gate electrode having a second coefficient of thermal expansion, where "said first gate dielectric and said first gate electrode are selected such that a difference between said second coefficient of thermal expansion and said first coefficient of thermal expansion causes a strain in said channel, said strain causing an increase in carrier mobility in said FET." Amended independent claim 15 recites similar limitations as amended independent claims 1 and 9 discussed above. Thus, for similar reasons as discussed above, amended independent claim 15 is also patentably distinguishable over Kubo. Thus claims 16 and 19 depending from amended independent claim 15 are, *a fortiori*, also patentably distinguishable over Kubo for at least the reasons presented above and also for additional limitations contained in each dependent claim.

B. Rejection of Claims 1-3, 6, 9-10, and 15-16 under 35 USC §102(e)

The Examiner has rejected claims 1-3, 6, 9-10, and 15-16 under 35 USC §102(e) as being anticipated by U.S. patent application publication number 2003/0034529 to Fitzgerald et al. ("Fitzgerald"). For the reasons discussed below, Applicants respectfully submit that the present invention, as defined by amended independent claims 1, 9, and 15, is patentably distinguishable over Fitzgerald.

In contrast to the present invention as defined by amended independent claims 1 and 9, Fitzgerald does not teach, disclose, or suggest a first gate dielectric having a first coefficient of thermal expansion and a first gate electrode having a second coefficient of thermal expansion, where "said first gate dielectric and said first gate electrode are selected such that a difference between said second coefficient of thermal expansion and said first coefficient of thermal expansion causes an increase in carrier mobility in said FET." Fitzgerald specifically discloses substrate structure 100 including gate 112, SiO_2 layer 110, silicon film 108, and SiGe film 106, where gate 112 is situated on SiO_2 layer 110, SiO_2 layer 110 is situated on silicon film 108, and silicon film 108 is situated on SiGe film 10. See, for example, page 2, paragraph [0026] and Figure 1 of Fitzgerald. In Fitzgerald, since the lattice constant of SiGe is larger than that of Si, the Si film is under biaxial tension and thus the carriers exhibit strain-enhanced mobilities. See, for example, Fitzgerald, page 2, paragraph [0026].

However, Fitzgerald fails to teach, disclose, or suggest a first gate dielectric and a first gate electrode being selected such that a difference between the second coefficient of thermal expansion of the first gate electrode and the first coefficient of thermal expansion of the first gate dielectric causes an increase in carrier mobility in the FET, as recited in amended independent claims 1 and 9. Furthermore, Fitzgerald fails to even mention a coefficient of thermal expansion. Moreover, in Fitzgerald, carriers exhibit strain-enhanced mobilities as a result of biaxial tension created by layers situated under a gate

dielectric layer, not by a difference in coefficients of thermal expansion of a gate electrode and a gate dielectric as specified in amended independent claims 1 and 9.

For the foregoing reasons, Applicants respectfully submit that the present invention, as defined by amended independent claims 1 and 9, is not taught, disclosed, or suggested by Fitzgerald. Thus, amended independent claims 1 and 9 are patentably distinguishable over Fitzgerald. As such, the claims 2-3 and 6-7 depending from amended independent claim 1 and claims 10 and 13 depending from amended independent claim 9 are, *a fortiori*, also patentably distinguishable over Fitzgerald for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The present invention, as defined by amended independent claim 15, includes, among other things, a first gate dielectric having a first coefficient of thermal expansion and a first gate electrode having a second coefficient of thermal expansion, where "said first gate dielectric and said first gate electrode are selected such that a difference between said second coefficient of thermal expansion and said first coefficient of thermal expansion causes a strain in said channel, said strain causing an increase in carrier mobility in said FET." Amended independent claim 15 recites similar limitations as amended independent claims 1 and 9 discussed above. Thus, for similar reasons as discussed above, amended independent claim 15 is also patentably distinguishable over Fitzgerald. Thus claims 16 and 19 depending from amended independent claim 15 are, *a*

fortiori, also patentably distinguishable over Fitzgerald for at least the reasons presented above and also for additional limitations contained in each dependent claim.

C. Rejection of Claims 7, 13, and 19 under 35 USC §103(a)

The Examiner has rejected claims 7, 13, and 19 under 35 USC §103(a) as being unpatentable over Kubo or Fitzgerald as applied to claims 1, 9, and 15. However, as discussed above, amended independent claims 1, 9, and 15 are patentably distinguishable over Kubo or Fitzgerald. Thus, claim 7 depending from amended independent claim 1, claim 13 depending from amended independent claim 9, and claim 19 depending from amended independent claim 15 are, *a fortiori*, also patentably distinguishable over Kubo or Fitzgerald for at least the reasons presented above and also for additional limitations contained in each dependent claim.

D. Conclusion

Based on the foregoing reasons, the present invention, as defined by amended independent claims 1, 9, and 15 and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 1-3, 6-7, 9-10, 13, 15-16, and 19 pending in the present application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early allowance of claims 1-3, 6-7, 9-10, 13, 15-16, and 19 pending in the present application is respectfully requested.

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Respectfully Submitted,
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